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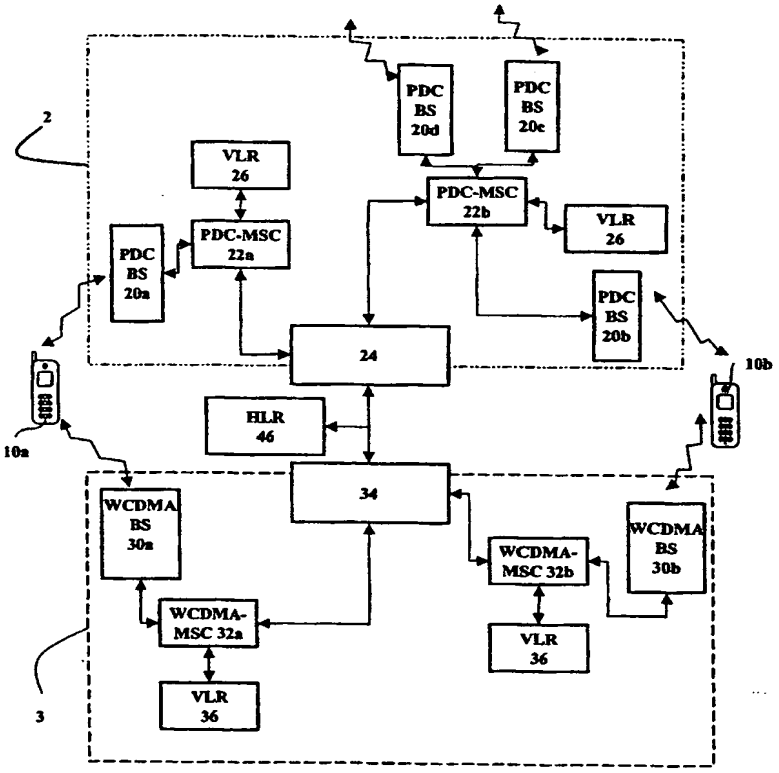
(54) Title: COMMUNICATION SYSTEM AND DUAL-MODE MOBILE STATION



(57) Abstract: A mobile communications system comprising a first network (2) operable with a first communication protocol, a second network (3) operable with a second communication protocol and a portable communication device (10) operable with the first and the second communication protocols. The first communication protocol results in a lower power consumption by the device whilst in a standby status than the second communication protocol. The device is arranged to default to the first protocol whenever the device enters a standby status. The device may also be arranged to default to the protocol which uses less power in an active status whenever the device enters an active status.

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COMMUNICATION SYSTEM AND DUAL-MODE MOBILE STATION

This invention relates to mobile telephony and in particular to telecommunications devices that are capable of operating in at least two telecommunications modes.

The evolution of mobile telephony has been very fast and different standards have arisen in many sectors of the globe. For instance, at the time of writing, GSM (Global System for Mobile) predominates in Europe, analogue (AMPS) dominates in the US and PDC dominates in Japan. This geographical domination is historical rather than technically meritous, different standards having been developed at different times in different regions.

Over recent years there has been great development in the field of portable radio devices such as mobile telephones, communicators and personal digital assistants (PDA). One limiting factor in the take-up of such devices is the life of the battery associated with the devices and much work has been carried out in this area.

Conventionally such devices have been developed to operate in a particular environment and with a particular transmission protocol but as the average consumer becomes more of a global traveller, the demand for devices which operate in any country with any protocol has arisen.

Such devices are known as dual-band, the device being able to operate using the same basic protocol but at more than one frequency, and dual-mode, in which a device can operate with more than protocol. Such a device allows a user to communicate using one of two modes or standards.

The currently emerging so-called 3rd generation standards that are currently being negotiated use a Code Division Multiple Access (CDMA) system with varying power levels for transmission. This mode can result in relatively high power consumption.

In accordance with the invention there is provided a portable communications device operative with at least two communication protocols, a first of which results in a lower power consumption by the device whilst in a standby status, the device being arranged to default to the first protocol whenever the device enters a standby status.

The invention is particularly applicable to for a device operable with a TDMA communication protocol and a CDMA communication protocol, the TDMA communication protocol being the first protocol and in particular the first protocol being PDC and the CDMA protocol being WCDMA.

Preferably the device is arranged to alter its mode of operation to the second communication protocol in response to a paging signal conforming to the first communication protocol. In this case, the device may be arranged, in response to the paging signal, to transmit a polling signal conforming to the second communication protocol.

According to a second aspect of the invention there is provided a mobile communications system comprising a first network operable with a first communication protocol; a second network operable with a second communication protocol; a portable communication device operable with the first and the second communication protocols; wherein the first communication protocol results in a lower power consumption by the device whilst in a standby status than the second communication protocol, the device

being arranged to default to the first protocol whenever the device enters a standby status.

Preferably, in response to a request from the second network, the first network is arranged to send a paging signal to the device to cause the device to alter its mode of operation to the second communication protocol. The device may be arranged, in response to the paging signal, to transmit a polling signal conforming to the second communication protocol and, in response to the polling signal, the second network is arranged to establish a connection to the device.

According to a third aspect of the invention there is provided a portable communications device operative with at least two communication protocols, a first of which results in a lower power consumption by the device whilst in an active status, the device being arranged to default to the first protocol whenever the device enters an active status.

The invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 shows an embodiment of a mobile communications device according to the invention;

Figure 2 shows the operational components of a mobile communications device according to the invention;

Figure 3 shows a typical arrangement of a mobile communications network, operable with two communications protocols.

Figure 1 shows an embodiment of a mobile communications device according to the invention. The device shown is a mobile phone handset 10 and comprises a display 101, data entry means in the form of a keypad 102, an antenna 103, an earpiece 104 and a microphone 105. The handset 10 is operable with two communications protocols. For exemplary purposes only, the mobile handset is operable with the PDC protocol (widely adopted in Japan) and Wideband-CDMA (WCDMA) protocol.

Figure 2 shows the operational components of the handset 10 that are of interest as far as describing the invention is concerned. The handset may also include other components which are not shown.

The handset comprises an antenna 103 for transmitting and receiving radio frequency (RF) signals. The antenna 103 is coupled to a transceiver 106, 107 for each protocol. Transceiver 106 receives and transmits signals conforming to PDC and transceiver 107 receives and transmits signals conforming to WCDMA.

The transceivers are coupled to a baseband unit 108 which converts the received RF signals from the transceivers 106, 107 into a baseband signal and converts baseband signals into RF signals to be transmitted via the transceivers 106, 107.

The baseband unit 108 is coupled to a processor 109 which controls the operation of the baseband unit and receives inputs from and outputs to the display 101, keypad 102 and Random Access Memory (RAM) 110.

The processor unit controls the operation of the device 10. RAM 110 stores information relating to the default mode of operation of the device and, in response to this information, the processor selects which transceiver 106, 107

to use when the device enters a standby state. In the exemplary embodiment, the information stored in the RAM 110 specifies that the device is to default to the PDC protocol whenever the device enters the standby state. Thus, when a user switches on the device 10, the processor switches in the PDC transceiver 106 and switches out the WCDMA transceiver 107. The device therefore sends out polling signals according to the PDC protocol.

Figure 3 shows a typical arrangement of a mobile communications system, operable with two communications protocols. For exemplary purposes only, the two communications protocols of PDC (the mobile telephony standard adopted in Japan) and WCDMA will be described.

The communications system comprises a first network 2 operative with the PDC protocol. This network comprises PDC base stations 20 and PDC-MSCs 22. The PDC base stations 20 transmit and receive signals conforming to the PDC protocol. These PDC base stations 20 communicate with the PDC Mobile Switching Centres (MSCs) 22. Element 24 encompasses other PDC-BS and PDC-MSC 22 which make up a PDC network.

The communications system also includes a second network 3 operative with the WCDMA protocol. This network comprises base stations 30 and WCDMA Mobile Switching Centres (MSCs) 32. The WCDMA base stations 30 transmit and receive signals conforming to the WCDMA protocol. These WCDMA base stations 30 communicate with the WCDMA-MSCs 32. Element 34 encompasses other WCDMA-BS and WCDMA-MSC 22 which make up a WCDMA network.

Thus, when the handset 10a wants to make a call to the handset 10b, the handset 10a transmits a signal which is picked up by a neighbouring base station 20a or 30a, passed via a Mobile Switching Centre 22a/32a around the

network 2,3 from where it is routed to the Mobile Switching Centre 22b/32b associated with the base station 20b/30b which is in communication with the destination handset 10b.

The communication system also has at least one Home Location Register (HLR) 46 which stores subscriber parameters. This information is added to the HLR whenever a new subscriber is added to the system. The data contained by the HLR is remotely accessed by the MSCs in the networks.

Associated with each PDC-MSC 22 is a Visitor Location Register (VLR) 26 and associated with each WCDMA-MSC 32 is a Visitor Location Register (VLR) 36. The VLR contains a copy of most of the data stored in the HLR 46. It is however temporary data which exists only for as long as the mobile device is active in the area covered by the VLR. In addition to the information stored in the HLR 46, the VLR 26/36 also typically includes information relating to the status of the device (busy/standby etc.), location area identity etc. The HLR 46 includes information regarding the current VLR 26/36 with which a mobile device 10 is registered.

Mobile devices have so-called "duty cycles" during which a device, such as handset 10, registers with a network. This enables the mobile networks to keep track of the location of the mobile device. Time Division Multiple Access (TDMA) systems such as PDC have relatively short "duty cycles". In TDMA, duty cycles typically comprise 1-2% of the time a mobile communications device is switched on and consume around 1.1mA of power. In WCDMA the duty cycle is comparable in duration (around 1%) but significantly more processing is carried out during the duty cycle compared with TDMA devices. This results in a higher power consumption for WCDMA duty cycles (typically 5.5mA if no diversity antenna is used and significantly more if a diversity antenna is used).

A communications device according to the invention is pre-configured to enter the most efficient mode when in standby. In the example of a PDC/WCDMA dual-mode phone, the phone is pre-configured to enter the PDC mode when in standby. Thus the device will have a standby time comparable with a single-mode PDC device.

A device may send, in the polling signal, information regarding the networks with which the device is operable. Thus, the MSC also stores in the VLR details concerning the dual-modality of the mobile station.

When the handset 10 is in standby, the handset carries out duty cycles only. During each duty cycle, the handset 10a transmits a polling signal formatted according to the PDC protocol. When in the vicinity of a PDC base station 20, the polling signal is received by the PDC base station, for instance base station 20a. The PDC base station 20a then sends a signal to the PDC Mobile Switching Centre 22a associated with the receiving base station 20a and the PDC Mobile Switching Centre 22a registers the location of the mobile station 10a in the associated Visitor Location Register (VLR) 26. If the polling signal also includes information regarding the other networks with which the handset can operate, this information is also stored in the VLR 26 associated with PDC-MSC 22a. In response to a polling signal which includes information relating to other networks, the receiving MSC messages the HLR 46 of the other network(s) with the information. Alternatively this information can be stored permanently in the HLR from the time the user of the device first registers with the service provider.

Let us consider the making of a PDC call from a mobile station 10b to a mobile station 10a. The transmitting device 10b transmits a signal in PDC mode which is picked up by the PDC-BS 20b. When the PDC mobile switching centre 22b receives the signal from the PDC-BS 20b, it interrogates

the HLR and detects that the mobile station being called is registered with the PDC-MSC 22a. The call is therefore switched through to the PDC-MCS 22a which, in turn, passes the call to the base station 20a with which the mobile station 10a is associated. The connection between the devices 10b and 10a is then established.

When the call is terminated, the processor 109 of the device 10a instructs the components of the device to default to the PDC mode of operation. Thus the device 10 resumes the transmission of polling signals on the PDC network during the duty cycles.

Since the mobile station 10a is programmed to enter the PDC mode whenever the mobile station is in standby, the mobile station 10a will not automatically register with the WCDMA network. Thus a call via the WCDMA network will not reach the mobile station when in PDC mode unless further action is taken.

Let us consider the making of a WCDMA call from a mobile station 10b to a mobile station 10a when the receiving mobile station 10a is in PDC mode. The transmitting device 10b is operating in WCDMA mode. When the WCDMA mobile switching centre 32b receives a signal from the mobile station 10b, it interrogates the HLR 46 and detects that the mobile station being called is not registered with any MSC of the WCDMA network. However the information in the HLR 46 indicates that the device being called is registered with a PDC-MSC. The WCDMA-MSC 32b therefore signals the identified network to see if the called device can be located. In this embodiment, the WCDMA-MSC 32b determines from the HLR 46 that the mobile station 10a is registered on the PDC network 2. The MSC 32b therefore sends a message to the PDC network 2 in an attempt to try to locate the device.

On receipt of the message from the WCDMA-MSC 32b, the PDC network 2 interrogates the HLR 46, detects that the mobile station being called is registered with the PDC-MSC 22a and sends the message to PDC-MSC 22a. The PDC-MSC 22a sends an acknowledgement message to the WCDMA-MSC 32b and sends a paging message to the destination mobile station 10a by means of the base station 20a.

In response to the paging message the processor 109 of the mobile station 10a instructs the device to synchronise to the WCDMA network. This is achieved by the processor 109 switching in the WCDMA transceiver 107 and sending a polling signal conforming to the WCDMA protocol. This polling signal is picked up by the WCDMA base station 30a and sent to the WCDMA-MSC 32a. This causes the mobile station 10a to be registered on the WCDMA network and the WCDMA call from the mobile station 10b can proceed. When the device is synchronised to the WCDMA network, the processor 109 switches out the PDC transceiver 106.

The location details for the mobile station 10a are stored in the VLR 36 associated with the WCDMA-MSC 32a, these details now indicating that the mobile station 10a is registered with the WCDMA network.

When the call from mobile station 10b is ended, the mobile station 10a will automatically revert to PDC mode i.e. during the next duty cycle after the end of a call, the mobile station 10a will send a polling signal using the PDC protocol. This polling signal is picked up by the PDC network so that synchronisation with the PDC network is achieved and the HLR is updated accordingly.

So that contact with the mobile station is not lost during the period when the mobile station is registering with a second network, the mobile station remains

synchronised with a first network until synchronisation with the second network is achieved.

A user of a multi-mode device may wish to select the mode of operation of the device, for instance by selecting WCDMA rather than PDC when a high data rate application is to be used. For this purpose, the device is provided with a over-ride option (e.g. via a user interface) to over-ride the default protocol. When this option is selected, the device proceeds to register with the selected network as described earlier.

As mentioned, the mobile station is configured to default to the protocol which uses less power consumption during standby. However, if the mobile station is unable to contact the network for this protocol the mobile station may be arranged to seek service with the alternative network. The mobile station is preferably arranged such that it will continue to send polling signals via the default network protocol. However this may not be as frequently as when contact is possible.

The invention has been described with reference to the standby operation of the mobile device. Additionally or alternatively the multi-mode device may be arranged to default, when active, to the mode which uses less power consumption when active. In the case of PDC and WCDMA this would be the PDC mode. If capacity is unavailable via the PDC network the device may be arranged to seek service with the alternative network.

The above description has focussed on a dual-mode PDC/WCDMA telephone. However it should be appreciated that the invention is applicable to any multi-mode phone where one operating protocol is more power efficient in standby. For example, in a dual-mode GSM/WCDMA device, the device would be arranged to default to the GSM mode since this results in less power

consumption during standby than the WCDMA mode. Although dual-mode devices have been discussed the invention is also applicable to devices with more than two modes of operation. For instance, a triple-mode telephone operative with AMPS/TDMA/CDMA would be arranged to default to the protocol which uses less power during standby.

CLAIMS

1. A portable communications device operative with at least two communication protocols, a first of which results in a lower power consumption by the device whilst in a standby status, the device being arranged to default to the first protocol whenever the device enters a standby status.

2. A device according to claim 1 wherein the device is operable with a TDMA communication protocol and a CDMA communication protocol, the TDMA communication protocol being the first protocol.

3. A device according to claim 2 wherein the first protocol is PDC and the CDMA protocol is WCDMA.

4. A device according to any of claims 1 to 3 wherein the device is arranged to alter its mode of operation to the second communication protocol in response to a paging signal conforming to the first communication protocol.

5. A device according to claim 4 wherein the device is arranged, in response to the paging signal, to transmit a polling signal conforming to the second communication protocol.

6. A mobile communications system comprising

a first network operable with a first communication protocol;

a second network operable with a second communication protocol;

a portable communication device operable with the first and the second communication protocols;

wherein the first communication protocol results in a lower power consumption by the device whilst in a standby status than the second

communication protocol, the device being arranged to default to the first protocol whenever the device enters a standby status.

7. A system according to Claim 6 wherein, in response to a request from the second network, the first network is arranged to send a paging signal to the device to cause the device to alter its mode of operation to the second communication protocol.

8. A system according to claim 7 wherein the device is arranged, in response to the paging signal, to transmit a polling signal conforming to the second communication protocol and, in response to the polling signal, the second network is .arranged to establish a connection to the device.

9. A portable communications device operative with at least two communication protocols, a first of which results in a lower power consumption by the device whilst in an active status, the device being arranged to default to the first protocol whenever the device enters an active status.

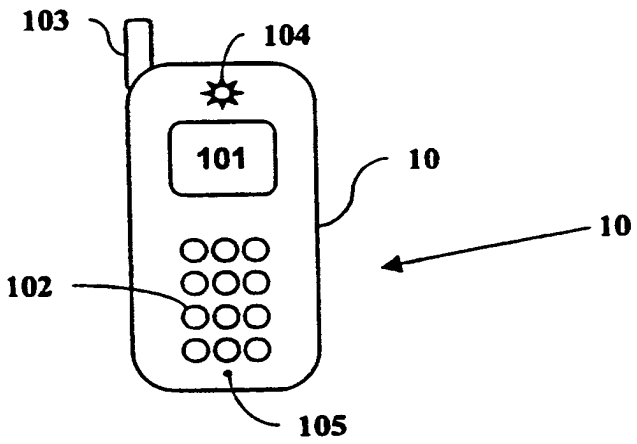

FIG 1

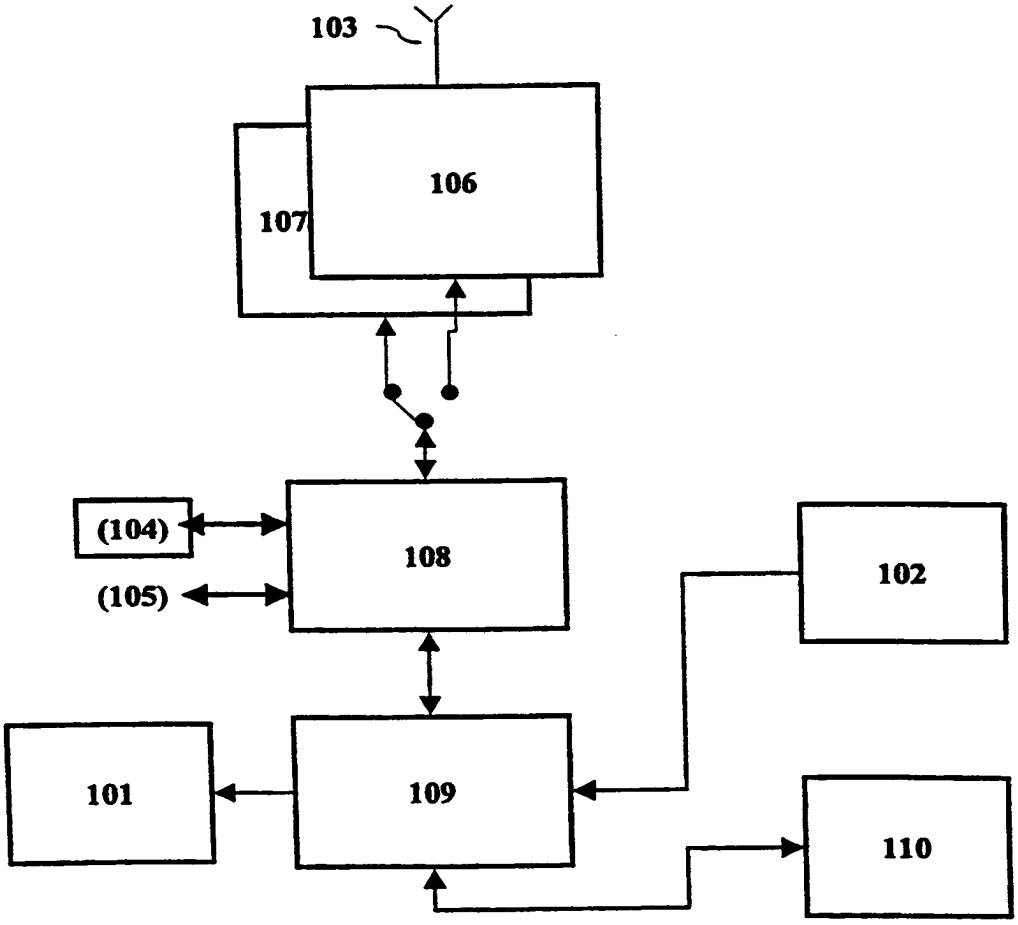

FIG 2

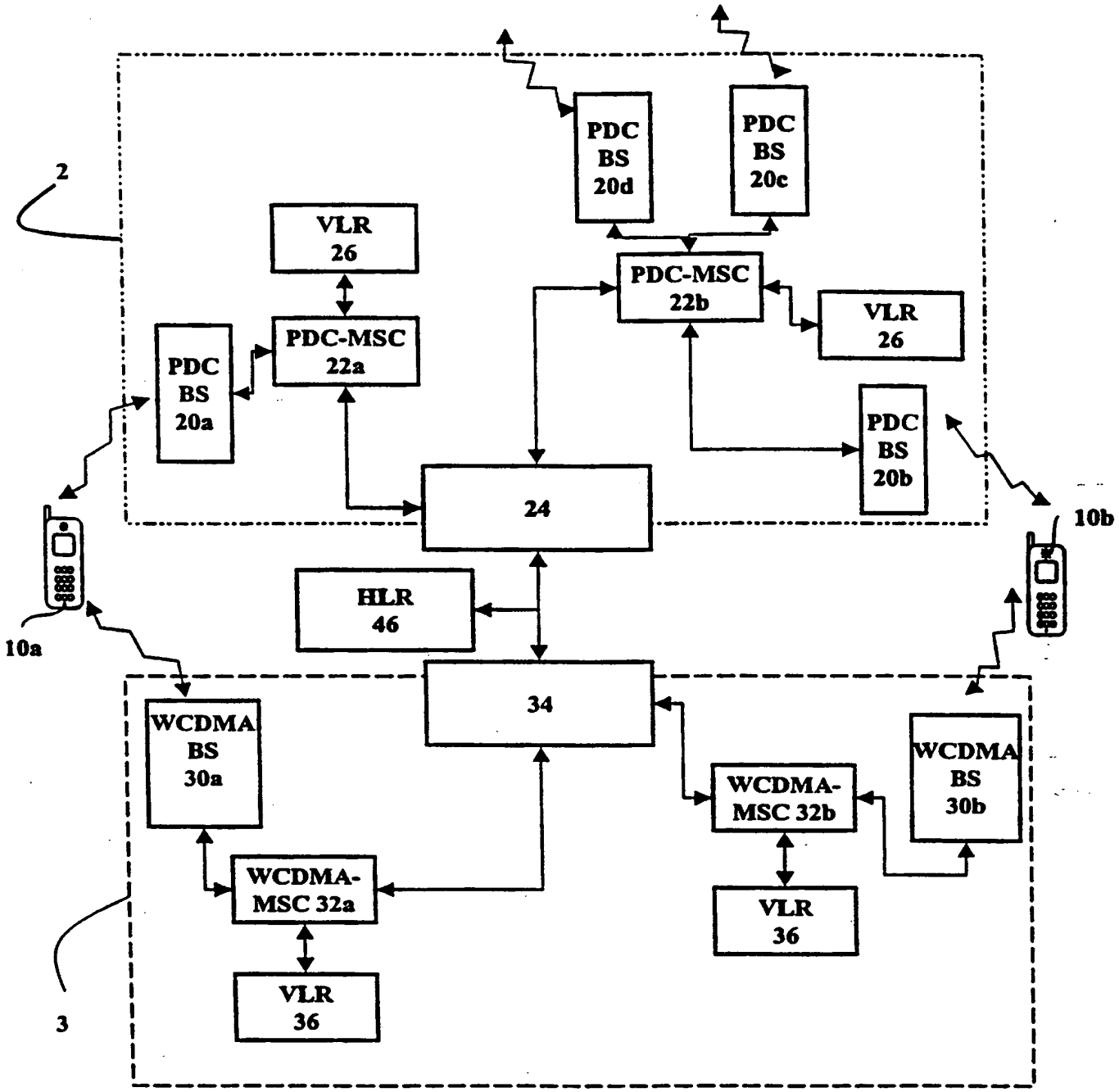

FIG 3

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/EP 00/07298

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 299 228 A (HALL) 29 March 1994 (1994-03-29) column 2, line 14 - line 57	1-9
X A	US 5 537 415 A (MILLER ET AL) 16 July 1996 (1996-07-16) column 1, line 35 - line 53 column 2, line 5 - line 13	1,6,7,9 2
A	EP 0 896 493 A (NIPPON ELECTRIC CO) 10 February 1999 (1999-02-10) column 2, line 34 -column 3, line 4	1,6,9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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24 October 2000	31/10/2000

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

...formation on patent family members

Inter ...nal Application No
PCT/EP 00/07298

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